

Abstract for 2012 AGU Fall Meeting

Session A039: Greenhouse Gas Measurements Using Active Optical Remote Sensing

A Regional CO₂ Observing System Simulation Experiment Using ASCENDS Observations and WRF-STILT Footprints

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Knowledge of the spatiotemporal variations in emissions and uptake of CO₂ is hampered by sparse measurements. The recent advent of satellite measurements of CO₂ concentrations is increasing the density of measurements, and the future mission ASCENDS (Active Sensing of CO₂ Emissions over Nights, Days and Seasons) will provide even greater coverage and precision. Lagrangian atmospheric transport models run backward in time can quantify surface influences ("footprints") of diverse measurement platforms and are particularly well suited for inverse estimation of regional surface CO₂ fluxes at high resolution based on satellite observations.

We utilize the STILT Lagrangian particle dispersion model, driven by WRF meteorological fields at 40-km resolution, in a Bayesian synthesis inversion approach to quantify the ability of ASCENDS column CO₂ observations to constrain fluxes at high resolution. This study focuses on land-based biospheric fluxes, whose uncertainties are especially large, in a domain encompassing North America. We present results based on realistic input fields for 2007. Pseudo-observation random errors are estimated from backscatter and optical depth measured by the CALIPSO satellite. We estimate a priori flux uncertainties based on output from the CASA-GFED (v.3) biosphere model and make simple assumptions about spatial and temporal error correlations. WRF-STILT footprints are convolved with candidate vertical weighting functions for ASCENDS. We find that at a horizontal flux resolution of 1 degree x 1 degree, ASCENDS observations are potentially able to reduce average weekly flux uncertainties by 0-8% in July, and 0-0.5% in January (assuming an error of 0.5 ppm at the Railroad Valley reference site). Aggregated to coarser resolutions, e.g. 5 degrees x 5 degrees, the uncertainty reductions are larger and more similar to those estimated in previous satellite data observing system simulation experiments.

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